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The Positive Pharmacy Care Law: An area-level analysis of the relationship between community pharmacy distribution, urbanity and social deprivation in England

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3 **The Positive Pharmacy Care Law: An area-level analysis of the relationship**
4 **between community pharmacy distribution, urbanity and social deprivation in**
5 **England**
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Abstract

Objectives: To: (1) determine the percentage of the population in England that have access to a community pharmacy within 20 minutes walk; (2) explore any relationship between the walking distance and urbanity; (3) explore any relationship between the walking distance and social deprivation; and (4) explore any interactions between urbanity, social deprivation and community pharmacy access.

Design: This area level analysis spatial study used postcodes for all community pharmacies in England. Each postcode was assigned to a population lookup table and Lower Super Output Area (LSOA). The LSOA was then matched to urbanity (urban, town and fringe, or village, hamlet and isolated dwellings) and deprivation decile (using the Index of Multiple Deprivation score).

Primary outcome measure: Access to a community pharmacy within 20 minutes walk.

Results: Overall, 89.2% of the population is estimated to have access to a community pharmacy within 20 minutes walk. For urban areas, that is 98.3% of the population, for town and fringe, 79.9% of the population, whilst for rural areas, 18.9% of the population. For areas of lowest deprivation (deprivation decile 1) 90.1% of the population have access to a community pharmacy within 20 minutes walk, compared to 99.8% in areas of highest deprivation (deprivation decile 10), a percentage difference of 9.6% (8.2, 10.9).

Conclusions: Our study shows that the majority of the population can access a community pharmacy within 20 minutes walk and crucially, access is greater in areas of highest deprivation – *a positive pharmacy care law*. More research is needed to explore the perceptions and experiences of people – from various levels of deprivation – around the accessibility of community pharmacy services.

Strengths and limitations of this study

- Our study is the first internationally to examine whether there is an inverse care law in relation to community pharmacies and the first to analyse geographical access to services in England.
- A key strength of this study is that we examined accessibility of community pharmacies by walking distance; the cost of driving and using public transport can be significant barriers to travel and, as such, may not give a true account of community pharmacy accessibility.
- A possible limitation is that a 20 minute walk from each community pharmacy was represented using a straight-line distance from the central point of each pharmacy's postcode to create a buffer. This assumes people walk in straight lines while, in reality, people are constrained to pathways that curve or are sometimes cut off by barriers.
- We did not consider the individual public health services offered from each community pharmacy

Background

The role of the community pharmacist has undergone rapid expansion in recent years with a significant emphasis now placed upon delivering public health focused services, including promoting healthy lifestyles and modification of health-related behaviours, rather than just the traditional role of compounding and dispensing.^{1,2} As such, in England, many community pharmacies now offer services, commissioned by local authorities, which are designed to help address public health priority conditions including smoking, alcohol misuse and obesity.³ These conditions were identified by *The Strategic Review of Health Inequalities in England* (the Marmot Review) as significant modifiable risk factors for inequalities in morbidity and mortality in England.^{4,5} It is clear from the Marmot Review and other research that the way in which society is organised causes inequalities in these conditions, and inequalities in these conditions are, in turn, major contributions to overall inequalities in health, morbidity and mortality. Significantly, more people die from these conditions in disadvantaged areas compared to more affluent ones.⁶⁻⁸ Access

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3 to healthcare services is a well-established social determinant of health:
4 disadvantaged areas often lack access to the level of NHS services that their health
5 needs require (such as primary care services). This has been termed as an *Inverse*
6 *Care Law*, as proposed by Tudor Hart in 1971, who stated '*the availability of good*
7 *medical care tends to vary inversely with the need for it in the population served*'.⁹

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10 Rural areas are often disadvantaged in accessing health care services such as GP
11 practices. Previous studies show that a 'distance decay' effect operates in accessing
12 health care services in rural areas, with GP consultation rates declining as the
13 distance from the GP surgery increases.¹⁰⁻¹² There is a common perception that
14 people in rural areas are more affluent and therefore healthier than their urban
15 counterparts, with a greater ability to adapt to, and access increasingly urbanised
16 health services.^{13,14} For the older population, who tend to have greater health care
17 needs accessing health care services may not be so easy, particularly those in rural
18 areas where there may be a lack of suitable transport.¹⁵

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21 Community pharmacies have to date been overlooked in discussions around access
22 to care, even though they could potentially make a significant contribution to this
23 issue as there are over 12,000 community pharmacies in England, distributed across
24 urban/rural and deprived/affluent areas. Estimates vary with regard to the reach of
25 this community pharmacy network, but some sources suggest over 90% of the
26 population makes at least one visit to the pharmacy per year.^{16,17} Evidence also
27 suggests that a range of patients – of varying age, gender and social class – visit
28 community pharmacies every month to collect prescriptions, purchase over-the-
29 counter (OTC) medicine and obtain general healthcare advice.¹⁸ Community
30 pharmacies therefore appear to be uniquely placed to deliver public health
31 initiatives and can also be accessed without the patient needing a prior appointment.
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33 This accessibility has consistently improved in recent years with policy drivers to
34 improve access to medicines – including the promotion of 'self-care' – with the
35 introduction of '100 hour pharmacies', which must open 100 hours per week, for
36 every week of the year. However, it is not understood if community pharmacies
37 offer easy and equitable access to healthcare and therefore contribute too, or
38 ameliorate, the inverse care law. Clearly, as with other health care services, for
39 community pharmacy public health services to be successful and to contribute to
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3 reducing inequalities in health, it is vital for these services to be available to the
4 areas and patient populations that need them most. This study, therefore, aims to:
5 (1) determine the percentage of the population in England that have access to a
6 community pharmacy within 20 minutes walk; (2) explore any relationship between
7 the walking distance (the accessibility) and urbanity; (3) explore any relationship
8 between the walking distance and social deprivation; and (4) explore any
9 interactions between urbanity, social deprivation and pharmacy access. The study is
10 the first internationally to examine whether there is an inverse care law in relation to
11 community pharmacies and the first to analyse geographical access to services in
12 England.
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22 **Methods**

23 *Data and variables*

24 Data were obtained from the *Durham Geo-HealthCare Database*. This database
25 contains data on the address and postcode of each community pharmacy in England
26 (obtained from the General Pharmaceutical Council – the independent regulator for
27 pharmacists, pharmacy technicians and pharmacy premises in Great Britain);¹⁹ the
28 postcode of each community pharmacy (matched to their corresponding coordinates
29 using the Office of National Statistics postcode directory, 2012);²⁰ the coordinates
30 for each postcode in England (also from the Office of National Statistics postcode
31 directory, 2012 - matched to a population lookup table and the Lower Super Output
32 Area [LSOA] for each postcode); whether the LSOA is urban (where the population is
33 over 10,000 people), town and fringe (part of a settlement with less than 10,000
34 people) or village, hamlet and isolated dwellings from the urban/rural classification
35 (2005)²¹ and the Index of Multiple Deprivation score (2010) for each LSOA (from the
36 Office of National Statistics).²² More details on the *Durham Geo-HealthCare*
37 *Database* are available here: <https://www.dur.ac.uk/wolfson.institute/geohealth/>
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53 *Analysis*

54 The community pharmacy postcodes for England were mapped using ArcMap. The
55 average person walks 1 mile (1.6km) in 20 minutes,²³ therefore 1.6 Km buffers were
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3 placed around each pharmacy to represent a 20 minute walk from a community
4 pharmacy. The population postcodes were then clipped to the pharmacy buffers.
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6 Data on the sum of the population for each LSOA overall and within each community
7 pharmacy buffer was extracted by LSOA. The percentage of the population with
8 access to a pharmacy within 20 minutes walk was then calculated by LSOA. Whether
9 or not the LSOA was urban, town and fringe or rural and the corresponding
10 deprivation score was attached to the data file. Deprivation deciles were also
11 calculated. The term 'deprivation decile' is used to group the population into ten
12 equally spaced ordinal categories according to a particular level of deprivation. Thus,
13 the most deprived decile (10) equates to the most deprived 10% within a population,
14 while the least deprived decile (1) represents the 10% of a population living in the
15 least deprived circumstances. Each data set was then mapped using Arc GIS. Tables
16 were produced to show the percentage of the population who had access to a
17 pharmacy within 20 minutes walk by deprivation decile and by urban/rural
18 classification within the deprivation deciles. Generalised linear models were used to
19 adjust for rurality within each deprivation decile to produce urban/rural adjusted
20 prevalence rates of the percentage of households with access to a pharmacy within
21 20 minutes walk by LSOA and the results tabulated.
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37 Results

38 Urban Rural/ Deprivation Decile Access

39 Data for all of the LSOAs in England shows that 89.2% of the population has access to
40 a community pharmacy within 20 minutes walk. 98.3% of the households in the
41 urban areas are estimated to have access to a pharmacy within 20 minutes walk. In
42 town and fringe, the percentage of households that have access to a community
43 pharmacy is estimated as 79.9% whilst the percentage of those in the rural areas is
44 estimated as 18.9%
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50 The distributions of percentages of households with access to a community
51 pharmacy within 20 minutes are presented in Table 1 (and shown spatially in Figure
52 1) according to their deprivation decile and urban, town and fringe and rural areas.
53 There is a significant non-linear association between the deprivation deciles (a u-
54 shaped access curve, see Figure 2): the least deprived and most deprived households
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3 have more access to a pharmacy than the households in the middle of the
4 deprivation range. Overall, the inequalities in access to pharmacies in England range
5 between 0.3% less and 20.2% less access when compared to the most deprived
6 areas. There are higher spatial inequalities in access in rural areas with ranges of
7 6.7% - 30.4% less access in comparison to 3.5% -26.2% for town and fringe, and 0.1%
8 - 3.7% for urban areas – spatial inequalities in access are thus much smaller in urban
9 areas.
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| Deprivation Decile (IMD) | ALL | | Urban | | Town and Fringe | | Village, Hamlet & Isolated Dwellings | |
|--------------------------|--------------------|---------------------------|--------------------|---------------------------|--------------------|---------------------------|--------------------------------------|---------------------------|
| | % Access (20 mins) | Compared to Most Deprived | % Access (20 mins) | Compared to Most Deprived | % Access (20 mins) | Compared to Most Deprived | % Access (20 mins) | Compared to Most Deprived |
| 1 – least deprived | 90.1 | -9.6(-10.9,-8.2)* | 96.2 | -3.7(-4.2, -3.2)* | 80.8 | -17.9(-28.6, -7.3)* | 37.3 | -6.7 (-34.4, 21.1) |
| 2 | 82.7 | -16.8(-18.1,-15.5)* | 96.2 | -3.7(-4.2, -3.1)* | 72.3 | -26.2(-36.8, -15.6)* | 24.1 | -20.2 (-47.7, 7.4) |
| 3 | 80.3 | -19.3(-20.6, -18.0)* | 96.4 | -3.5(-4.0, -2.9)* | 79.1 | -19.6(-30.3, -8.8)* | 19.5 | -25.0 (-52.5, 2.6) |
| 4 | 79.1 | -20.2(-21.5, -18.9)* | 97.7 | -2.1(-2.6, -1.6)* | 77.5 | -20.9(-31.7, -10.1)* | 15.2 | -29.1 (-56.6, -1.6)* |
| 5 | 81.9 | -17.4(-18.7, -16.1)* | 98.1 | -1.8(-2.3, -1.3)* | 75.7 | -22.1(-32.9, -11.2)* | 14.0 | -30.4 (-58.0, -2.9)* |
| 6 | 87.6 | -12.2(-13.5, -10.9)* | 98.5 | -1.4(-1.9, -0.9)* | 83.2 | -15.6(-26.5, -4.6)* | 14.6 | -30.0 (-57.5, -2.4)* |
| 7 | 94.0 | -5.8 (-7.1, -4.5)* | 99.1 | -0.8(-1.3, -0.3)* | 88.8 | -10.4 (-21.6, .7) | 16.1 | -27.9 (-55.6, -0.1)* |
| 8 | 97.6 | -2.2 (-3.5, -0.9)* | 99.4 | -0.5(-1.0, 0.0)* | 88.6 | -11. (-22.6, .7) | 26.1 | -17.8 (-46.2, 10.6) |
| 9 | 99.5 | -0.3 (-1.6, 1.0) | 99.7 | -0.1 (-0.6, 0.3) | 95.7 | -3.5 (-16.1, 9.1) | 51.6 | 10.7 (-21.3, 42.7) |
| 10 – most deprived | 99.8 | 0 | 99.9 | 0 | 99.9 | 0 | 42.6 | 0 |

* Significant at $p < 0.05$

Table 1: The percentage of the population with access to a community pharmacy within a 20 minute walk by urbanity and deprivation decile (with 95% Confidence Intervals).

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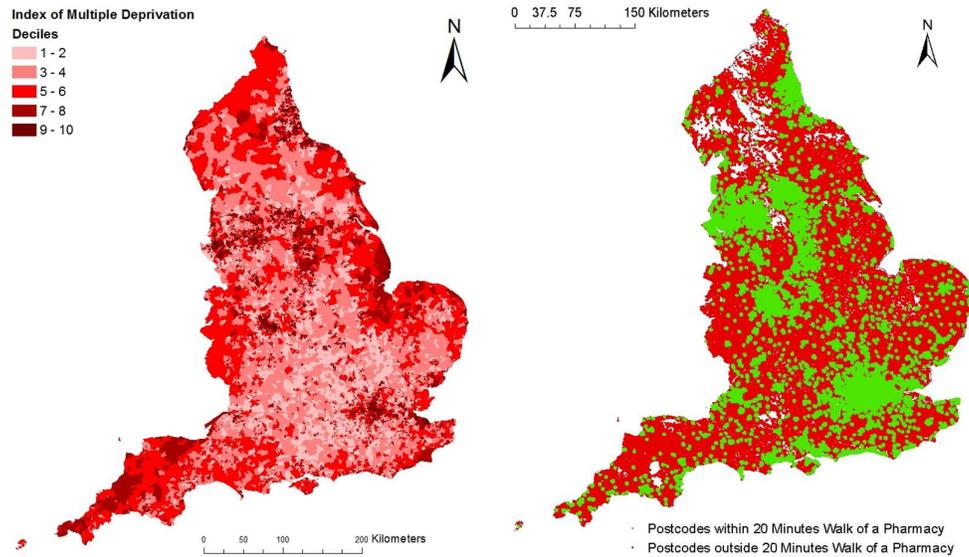


Figure 1: Map of England with LSOA stratified according to deprivation (left); and the population with access to a community pharmacy within 20 minutes walk (right).

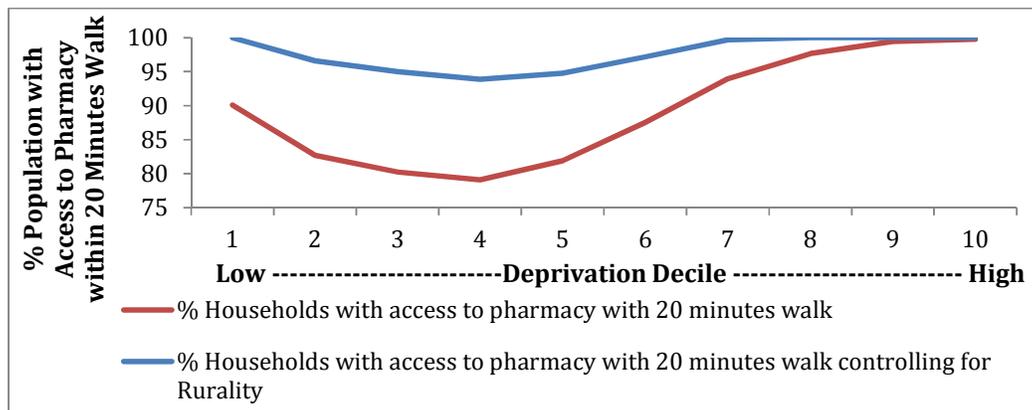


Figure 2: Percentage of the Population with Access to a Pharmacy within 20 Minutes' Walk by Deprivation Decile before and after Adjusting for Urbanity

Urban areas have the least difference between the most and least deprived LSOAs with only 3.7% less of the population having access to a pharmacy within 20 minutes' walk in the least deprived LSOAs. In town and fringe LSOAs this rose to 17.9% difference, whilst in rural areas there was no significant difference between the least and most deprived LSOAs.

Finally, in order to investigate interactions between deprivation deciles and urbanity levels we compared the difference in the percentage of the population that have access to a pharmacy within 20 minutes' walk between urbanity levels across the deprivation deciles (Table 2). There is a significant difference between urban and town/fringe in all deprivation deciles except the most deprived (decile 10). The biggest differences in access to community pharmacies are between urban and rural areas. There are significant interactions between access to community pharmacies and urbanity levels: difference in access depends on deprivation decile. The inequality gap between urban and town/fringe for the least and the most deprived areas are 15.1% and 0.9%, respectively. For the comparison between urban and rural areas, the inequality gap for the least and most deprived areas are 58.3% and 55.3%, respectively. Whilst the gap between town/fringe and rural areas are 43.2% and 54.5% respectively for the least and most deprived areas. In addition, there is a clear dose-response relationship between access to community pharmacies and urbanity levels. Specifically, the urban areas have more access to community

pharmacies, followed by Town/Fringe whilst the rural areas have the least access to pharmacies – regardless of deprivation.

| Deprivation Decile | Urban – Town/Fringe Difference | Urban – Rural Difference | Town/Fringe – Rural Difference |
|--------------------|--------------------------------|--------------------------|--------------------------------|
| 1 Least deprived | 15.1 (12.7, 17.5)* | 58.3 (24.5, 62.2)* | 43.2 (38.9, 47.5)* |
| 2 | 23.4 (20.7, 26.0)* | 71.8 (68.9, 74.7)* | 48.4 (44.9, 52.0)* |
| 3 | 16.9 (14.4, 19.5)* | 76.8 (74.5, 79.1)* | 59.8 (56.8, 63.0)* |
| 4 | 19.7 (17.2, 22.1)* | 82.3 (80.3, 84.3)* | 62.7 (59.8, 65.5)* |
| 5 | 21.1 (18.7, 23.5)* | 84.0 (81.9, 86.0)* | 62.8 (59.9, 65.7)* |
| 6 | 15.0 (12.8, 17.2)* | 83.9 (81.8, 85.9)* | 68.9 (66.1, 71.7)* |
| 7 | 10.5 (8.6, 12.4)* | 82.4 (80.2, 84.5)* | 71.9 (69.1, 74.7)* |
| 8 | 11.3 (9.5, 13.1)* | 72.6 (69.7, 75.5)* | 31.3 (58.0, 64.6)* |
| 9 | 4.2 (2.8, 5.6)* | 44.5 (40.7, 48.3)* | 40.3 (36.2, 44.3)* |
| 10 Most deprived | 0.9 (-0.2, 1.9) | 55.3 (50.8, 58.1)* | 54.5 (50.8, 58.1)* |

* Significant at $p < 0.05$

Table 2: Difference in the percentage of the population that have access to a pharmacy within 20 minutes' walk between urbanity levels and deprivation bands

Discussion

Principal findings of this study

The data has shown that 89 per cent of the population in England has access to a community pharmacy within 20 minutes walk. Crucially, there is a positive trend between community pharmacy accessibility and deprivation decile – with the highest access in the most deprived areas – showing there is no inverse pharmacy law for community pharmacy distribution in England. Indeed we have found evidence of a *positive pharmacy care law*. Populations in urban areas of England also have better access to a community pharmacy, compared to populations in town and fringe, and rural areas.

Strengths and weaknesses

This study sought to explore the accessibility of community pharmacies in England by walking distance: this is a key strength. We deliberately did not seek to explore accessibility by car or by using public transport, as we feel this would not give a true picture of accessibility for patients living in more deprived areas. Indeed, as access to a car is linked to income – with households in underprivileged areas having less access²⁴ – it is conceivable that this may be more of a significant barrier for patients living in deprived areas if the pharmacy was only accessible by driving; similarly, for public transport, the cost of using such services may prove to be a barrier to households with low incomes.²⁵ In terms of study limitations, while we believe our results are robust and have important implications for the commissioning of public health services from community pharmacy settings, we acknowledge that, in the analysis, we did not consider the individual services offered from each community pharmacy, which may show some local variability due to current commissioning systems. We also acknowledge that our work only explores accessibility from a geographical viewpoint and not a social perspective. Indeed, just because a community pharmacy offers a public health service and is within walking distance of a particular household does not necessarily mean that people perceive them as valuable or would be willing to access the service. Indeed, the literature shows that most users of community pharmacies are not offered public health services, although for those that had used them, satisfaction levels were high.²⁶ However, it is not yet known if people perceive community pharmacies as easily accessible providers of healthcare or if (or how) these perceptions change according to deprivation. A study exploring the perceptions and experiences of people – from various levels of deprivation – around the accessibility of community pharmacy services is therefore warranted. In terms of a methodological viewpoint, we recognize a 20-minute walk from each community pharmacy was represented using a straight-line distance from the central point of each pharmacy's postcode to create a buffer. This assumes people are able to walk in any direction from that postcode and always in a straight-line. In reality people are constrained to pathways that may curve, or even be cut off by barriers. A further limitation is that of the postcodes themselves. An individual postcode represents an average of 15 addresses, with the

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3 coordinates of each postcode being represented using the geographic centroid of
4 each postcode. Particularly in rural areas, where houses are more sparsely spread,
5 this could ostensibly mean that some households will fall outside of a pharmacy
6 buffer, when in fact this is not the case for some addresses. Equally, however, some
7 addresses will fall inside a buffer, so, over a large population, one would expect this
8 issue to even out.
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10 11 12 13 14 15 *What is already known?* 16

17 There have been several mapping studies published exploring the distribution and
18 accessibility of community pharmacies in areas of America and Canada. For example,
19 a study by Lin (2004) explored the accessibility of community pharmacies by elderly
20 patients in Illinois and sought to estimate the disparity between urban and rural
21 areas. The study found that, on average, there were 1.27 and 0.38 pharmacies per
22 10,000 people in urban and rural areas, respectively. In terms of accessibility, the
23 average distance for an elderly patient was 0.9 miles in urban areas but significantly
24 higher at 5.9 miles in rural areas.²⁷ While Law *et al.*, (2011) examined the
25 geographical access to community pharmacies in Ontario and found over 60 per cent
26 of the population reside within walking distance of at least one community
27 pharmacy.²⁸ Our original work shows geographical accessibility is even higher in
28 England. Despite studies published concerning community pharmacies in America
29 and Canada, there has been no study published in the literature that has explored
30 accessibility of community pharmacies in England. The recent White Paper
31 *Pharmacy in England: Building on Strengths – delivering the future*, published by the
32 Department of Health in 2008, claimed that, in England, 99 per cent of the
33 population can get to a pharmacy within 20 minutes by car and 96 per cent by
34 walking or using public transport.² However, whilst our report supports this finding
35 to some extent, it was not clear which methodological approach was used to obtain
36 this result as no supporting data were published; and – crucially - the Department of
37 Health report did not assess how varying levels of social deprivation influence the
38 accessibility to a community pharmacy. In addition, since the publication of the
39 White Paper and report, many more community pharmacies have since been opened
40 in England. Previous research has shown that community pharmacies can potentially
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3 make a positive contribution toward improving the public's health: areas of
4 particular strengths appear to be related to interventions around smoking cessation,
5 lipid management, emergency hormonal contraception and immunization.²⁹ By way
6 of example, several small-scale studies have compared accessibility of emergency
7 hormonal contraception (EHC) from a community pharmacy setting to other
8 healthcare providers. These studies have shown that women who went to a
9 community pharmacy had more rapid access to EHC, compared to other settings,
10 such as family planning clinics.³⁰⁻³¹ Given that the effectiveness of EHC is related to
11 how quickly it is taken after unprotected sexual intercourse this may prove to have a
12 significant clinical benefit. Other studies, rather than explore accessibility as such,
13 have used community pharmacies to target public health interventions towards
14 'hard to reach' areas. For example, Murphy *et al.*, showed community pharmacies
15 are convenient and accessible, and can provide influenza vaccination programs in
16 medically underserved communities, while Kellow (2011) successfully delivered a
17 community pharmacy weight management program to young adults in a rural
18 setting.³²⁻³³ These studies demonstrate the potential for community pharmacies to
19 deliver public health interventions to areas of the greatest need.
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34 35 *Implications for policy makers*

36 This is the first study to explore the spatial distribution of community pharmacies in
37 England. It is also the first international study that examines the relationship
38 between accessibility of community pharmacies and social deprivation and to
39 explore the idea of an *inverse pharmacy care law*. The paper shows that community
40 pharmacies are easily accessible by the majority of the population in England, with
41 89 per cent able access a community pharmacy within 20 minutes walk. Our study
42 also shows that there is no inverse pharmacy law for community pharmacies in
43 England: access to a community pharmacy is greater in areas of higher deprivation
44 compared to more affluent areas – a *positive pharmacy care law*. This is a very
45 timely finding as a recent initiative led by NHS England – the *Call to Action* – is
46 seeking to develop local strategy for community pharmacy initiatives and inform
47 strategic policy making in terms of commissioning community pharmacy services.³⁴
48 Our work supports this initiative and shows that community pharmacies are uniquely
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3 placed in the community to deliver public health interventions. In addition, as the
4 accessibility of community pharmacies is greatest in areas of highest deprivation,
5 they may have an important role to play in reducing inequalities in priority public
6 health conditions in England.
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10 11 12 **Conclusions**

13 Community pharmacies have the potential to offer convenient and equitable access
14 to healthcare. The vast majority of households in England – including those in the
15 most deprived areas – have access to a community pharmacy within 20 minutes
16 walk: a positive pharmacy care law. This potentially has major implications for the
17 commissioning of future public health services from community pharmacies in
18 England.
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24 25 26 **Contributorship statement**

27 AT and CB conceptualised and designed the study and were involved in
28 methodological development, analysis and interpretation. AC, AK and AH were
29 involved in the development of the methods, data analysis and interpretation. AT
30 led the drafting of the manuscript with input from all authors. All authors approved
31 the final version and AT has responsibility for its final content.
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38 39 **Competing interests**

40 None
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42

43 44 **Funding statement**

45 This research received no specific grant from any funding agency in the public,
46 commercial or not-for-profit sectors
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50 51 **Data sharing**

52 All of the primary data sources used to compile the database for this study are
53 referenced within the manuscript. We are unable to share the study database but
54 information related to it is available at:
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3 <https://www.dur.ac.uk/wolfson.institute/geohealth/>. The final raw analysed data is
4 available by e-mailing AT (adam.todd@durham.ac.uk).
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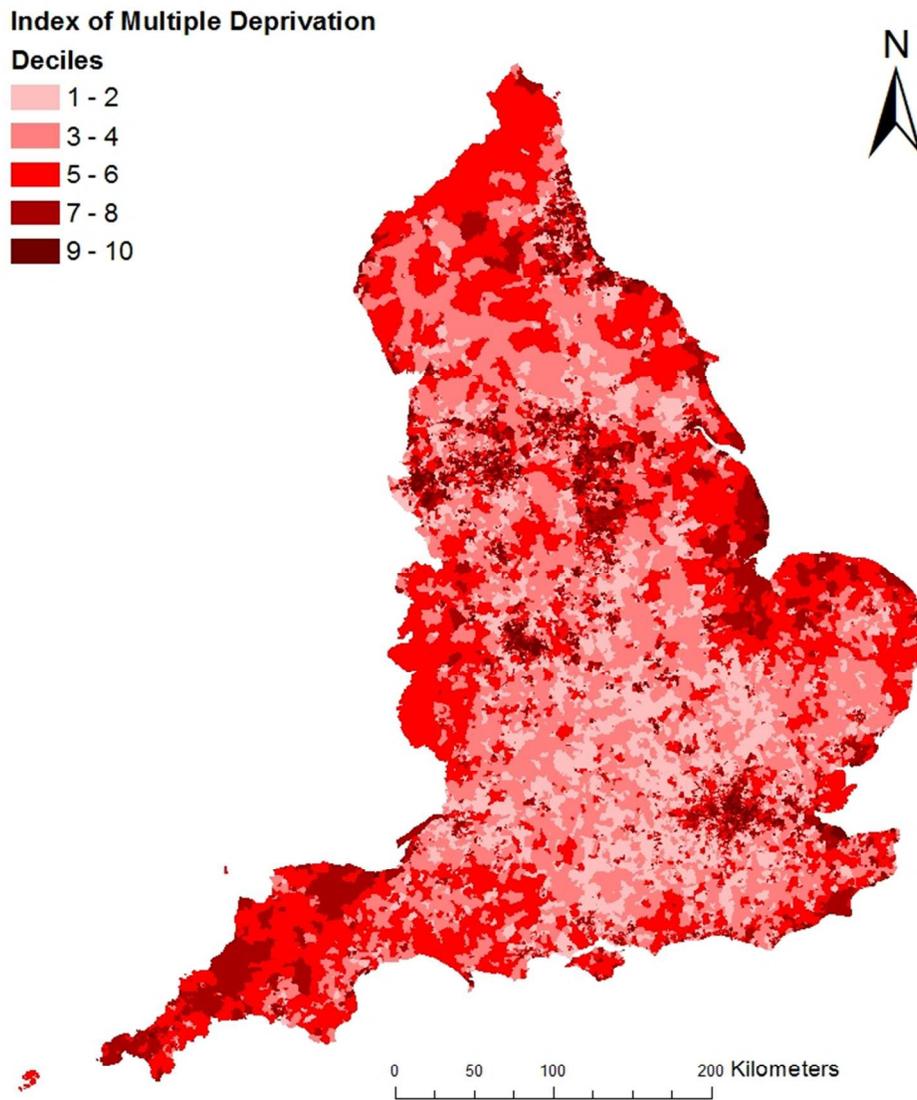


Figure 1: Map of England with LSOA stratified according to deprivation (left);
210x250mm (96 x 96 DPI)

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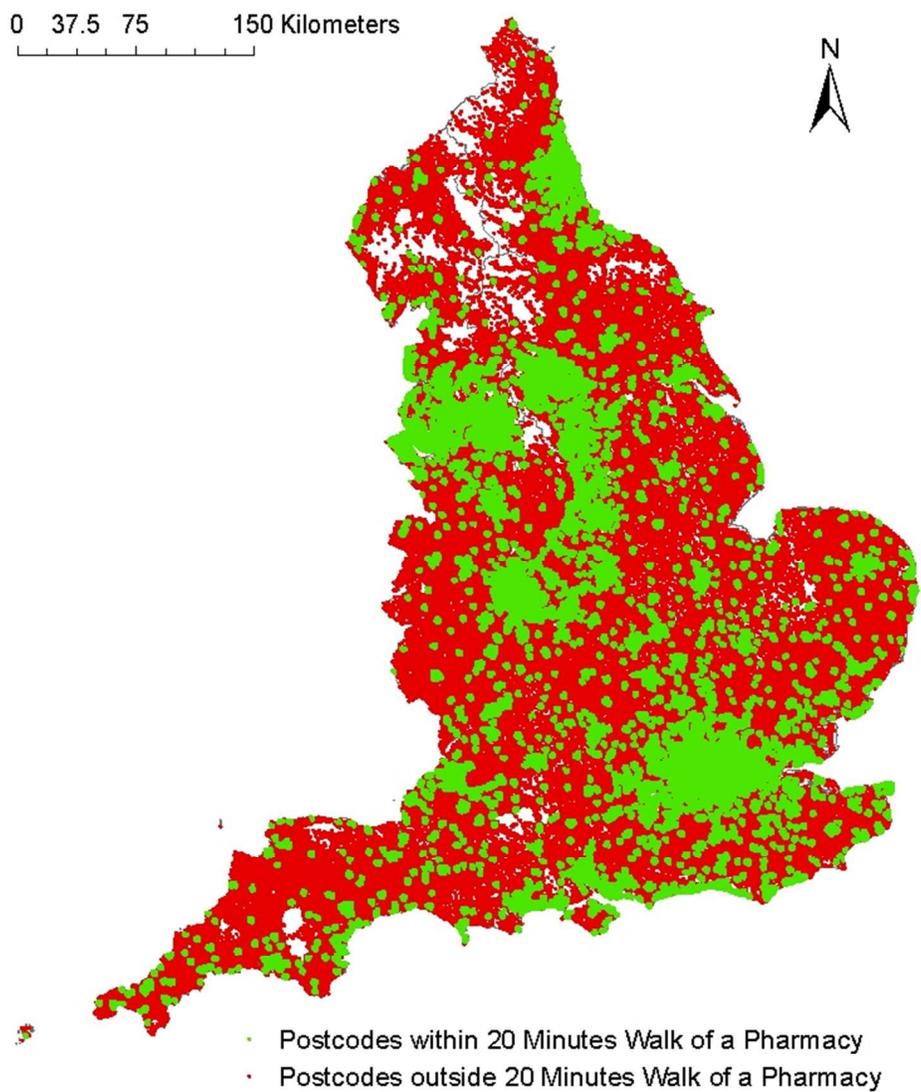


Figure 1 (cont): and the population with access to a community pharmacy within 20 minutes walk (right).
210x250mm (96 x 96 DPI)

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The Positive Pharmacy Care Law: An area-level analysis of the relationship between community pharmacy distribution, urbanity and social deprivation in England

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3 **The Positive Pharmacy Care Law: An area-level analysis of the relationship**
4 **between community pharmacy distribution, urbanity and social deprivation in**
5 **England**
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Abstract

Objectives: To: (1) determine the percentage of the population in England that have access to a community pharmacy within 20 minutes walk; (2) explore any relationship between the walking distance and urbanity; (3) explore any relationship between the walking distance and social deprivation; and (4) explore any interactions between urbanity, social deprivation and community pharmacy access.

Design: This area level analysis spatial study used postcodes for all community pharmacies in England. Each postcode was assigned to a population lookup table and Lower Super Output Area (LSOA). The LSOA was then matched to urbanity (urban, town and fringe, or village, hamlet and isolated dwellings) and deprivation decile (using the Index of Multiple Deprivation score).

Primary outcome measure: Access to a community pharmacy within 20 minutes walk.

Results: Overall, 89.2% of the population is estimated to have access to a community pharmacy within 20 minutes walk. For urban areas, that is 98.3% of the population, for town and fringe, 79.9% of the population, whilst for rural areas, 18.9% of the population. For areas of lowest deprivation (deprivation decile 1) 90.1% of the population have access to a community pharmacy within 20 minutes walk, compared to 99.8% in areas of highest deprivation (deprivation decile 10), a percentage difference of 9.6% (8.2, 10.9).

Conclusions: Our study shows that the majority of the population can access a community pharmacy within 20 minutes walk and crucially, access is greater in areas of highest deprivation – *a positive pharmacy care law*. More research is needed to explore the perceptions and experiences of people – from various levels of deprivation – around the accessibility of community pharmacy services.

Strengths and limitations of this study

- Our study is the first to systematically examine whether there is an inverse care law in relation to community pharmacies and the first to analyse geographical access to services in England.
- A key strength of this study is that we examined accessibility of community pharmacies by walking distance; the cost of driving and using public transport can be significant barriers to travel and, as such, may not give a true account of community pharmacy accessibility.
- A possible limitation is that a 20 minute walk from each community pharmacy was represented using a straight-line distance from the central point of each pharmacy's postcode to create a buffer. This assumes people walk in straight lines while, in reality, people are constrained to pathways that curve or are sometimes cut off by barriers.

Background

The role of the community pharmacist has undergone rapid expansion in recent years with a significant emphasis now placed upon delivering patient focused services, including promoting healthy lifestyles and modification of health-related behaviours, as well as providing medicine related activities.^{1,2} This change has been acknowledged in England through the NHS contractual framework for community pharmacy, which has 3 distinct levels of service: essential, advanced and locally commissioned.³ The essential and advanced levels of service are provided by all community pharmacies in England and include dispensing medication and providing medicine use reviews (MURs), while the locally commissioned services are provided in response to needs of the local population. As such, many community pharmacies now offer services, commissioned by local authorities according to need, which are designed to help address public health priorities including smoking, alcohol misuse and obesity.⁴ These issues were identified by *The Strategic Review of Health Inequalities in England* (the Marmot Review) as significant modifiable risk factors for inequalities in morbidity and mortality in England.^{5,6} It is clear from the Marmot Review and other research that the way in which society is organised causes inequalities in these conditions, and inequalities in these conditions are, in turn, major contributions to overall inequalities in health, morbidity and mortality. Significantly, more people die from these conditions in disadvantaged areas compared to more affluent ones.⁷⁻⁹ Access to healthcare services is a well-established social determinant of health: disadvantaged areas often lack access to the level of NHS services that their health needs require (such as primary care services). This has been termed as an *Inverse Care Law*, as proposed by Tudor Hart in 1971, who stated '*the availability of good medical care tends to vary inversely with the need for it in the population served*'.¹⁰

Rural areas are often disadvantaged in accessing health care services such as GP practices. Previous studies show that a 'distance decay' effect operates in accessing health care services in rural areas, with GP consultation rates declining as the distance from the GP surgery increases.¹¹⁻¹³ There is a common perception that

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3 people in rural areas are more affluent and therefore healthier than their urban
4 counterparts, with a greater ability to adapt to, and access increasingly urbanised
5 health services.^{14,15} For the older population, who tend to have greater health care
6 needs accessing health care services may not be so easy, particularly those in rural
7 areas where there may be a lack of suitable transport.¹⁶
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14 Community pharmacies have, to date, been overlooked in discussions around access
15 to care, even though they could potentially make a significant contribution to this
16 issue as there are over 12,000 community pharmacies in England, distributed across
17 urban/rural and deprived/affluent areas. Estimates vary with regard to the reach of
18 this community pharmacy network, but some sources suggest over 90% of the
19 population makes at least one visit to the pharmacy per year.^{17,18} Evidence also
20 suggests that a range of patients – of varying age, gender and social class – visit
21 community pharmacies every month to collect prescriptions, purchase over-the-
22 counter (OTC) medicine and obtain general healthcare advice.¹⁹ Community
23 pharmacies therefore appear to be uniquely placed to deliver healthcare initiatives
24 and can also be accessed without the patient needing a prior appointment. This
25 accessibility has consistently improved in recent years with policy drivers to improve
26 access to medicines – including the promotion of ‘self-care’ – with the introduction
27 of ‘100 hour pharmacies’, which must open 100 hours per week, for every week of
28 the year. However, it is not understood if community pharmacies offer easy and
29 equitable access to healthcare and therefore contribute to, or ameliorate, the
30 inverse care law. Clearly, as with other healthcare services, for community
31 pharmacy services to be successful and to contribute to reducing inequalities in
32 health, it is vital for these services to be available to the areas and patient
33 populations that need them most. This study, therefore, aims to: (1) determine the
34 percentage of the population in England that have access to a community pharmacy
35 within 20 minutes walk; (2) explore any relationship between the walking distance
36 (the accessibility) and urbanity; (3) explore any relationship between the walking
37 distance and social deprivation; and (4) explore any interactions between urbanity,
38 social deprivation and pharmacy access. The study is the first to examine whether
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5 analyse geographical access to services in England.
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8 **Methods**

9 *Study Design*

10 This study explores the relationship between spatial access to community
11 pharmacies, deprivation and urbanity using geographical information systems and
12 generalized linear models.
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17 *Outcome*

18 The percentage of the population that had access to a community pharmacy within a
19 20 minute walk by LSOA: measured as a straight line distance from each pharmacy
20 (1.6 km buffers) and aggregating the population by postcode within each buffer
21 compared to the LSOA population.
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26 *Definitions*

27 Community Pharmacy: Registered with the General Pharmaceutical Council as
28 premises for the compounding, procurement, storage and distribution of medicines
29 and appliances; we excluded premises that were solely registered as Internet
30 pharmacies in the analysis.
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36 LSOA – Lower Super Output Area: Geographic areas in England comprising of
37 approximately 1,500 residents and 650 households. They are designed to be of a
38 reasonably compact shape whilst being representative of social homogeneity.²⁰
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41 Urban/Rural Classification: Categorizes each LSOA into 3 settlement types: urban
42 (where the population is over 10,000 people), town and fringe (part of a settlement
43 with less than 10,000 people) or village, hamlet and isolated dwellings²¹
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47 Deprivation decile: The term 'deprivation decile' is used to group the population into
48 ten equally spaced ordinal categories according to a particular level of deprivation.
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51 *Data and variables*

52 Data were obtained from the *Fuse Geo-HealthCare Database*. This database contains
53 data on the address and postcode of each community pharmacy in England
54 (obtained from the General Pharmaceutical Council – the independent regulator for
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3 pharmacists, pharmacy technicians and pharmacy premises in Great Britain);²² the
4 postcode of each community pharmacy (matched to their corresponding coordinates
5 using the Office of National Statistics postcode directory, 2012);²³ the coordinates
6 for each postcode in England (also from the Office of National Statistics postcode
7 directory, 2012 - matched to a population lookup table and the Lower Super Output
8 Area [LSOA] for each postcode); whether the LSOA is urban (where the population is
9 over 10,000 people), town and fringe (part of a settlement with less than 10,000
10 people) or village, hamlet and isolated dwellings from the urban/rural classification
11 (2005)²¹ and the Index of Multiple Deprivation score (2010) for each LSOA (from the
12 Office of National Statistics).²⁴ More details on the *Fuse Geo-HealthCare Database*
13 are available here: <https://www.dur.ac.uk/wolfson.institute/geohealth/>
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25 *Analysis*

26 The community pharmacy postcodes for England were mapped using ArcMap. The
27 average person walks 1 mile (1.6km) in 20 minutes,²⁵ therefore 1.6 Km buffers were
28 placed around each pharmacy to represent a 20 minute walk from a community
29 pharmacy. The population postcodes were then clipped to the pharmacy buffers.
30 Data on the sum of the population for each LSOA overall and within each community
31 pharmacy buffer was extracted by LSOA. The percentage of the population with
32 access to a pharmacy within 20 minutes walk was then calculated by LSOA. Whether
33 or not the LSOA was urban, town and fringe or rural and the corresponding
34 deprivation score was attached to the data file. Deprivation deciles were also
35 calculated. The most deprived decile (10) equates to the most deprived 10% within
36 a population, while the least deprived decile (1) represents the 10% of a population
37 living in the least deprived circumstances. Each data set was then mapped using Arc
38 GIS. Tables were produced to show the percentage of the population who had
39 access to a pharmacy within 20 minutes walk by deprivation decile and by
40 urban/rural classification within the deprivation deciles. Generalised linear models
41 were used to adjust for rurality within each deprivation decile to produce
42 urban/rural adjusted prevalence rates of the percentage of households with access
43 to a pharmacy within 20 minutes walk by LSOA and the results tabulated.
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Results

Urban Rural/ Deprivation Decile Access

Data for all of the LSOAs in England shows that 89.2% of the population has access to a community pharmacy within 20 minutes walk. 98.3% of the households in the urban areas are estimated to have access to a pharmacy within 20 minutes walk. In town and fringe, the percentage of households that have access to a community pharmacy is estimated as 79.9% whilst the percentage of those in the rural areas is estimated as 18.9%.

The distributions of percentages of households with access to a community pharmacy within 20 minutes are presented in Table 1 (and shown spatially in Figures 1 and 2) according to their deprivation decile and urban, town and fringe and rural areas. There is a significant non-linear association between the deprivation deciles (a u-shaped access curve, see Figure 3): the least deprived and most deprived households have more access to a pharmacy than the households in the middle of the deprivation range. Overall, the inequalities in access to pharmacies in England range between 0.3% less and 20.2% less access when compared to the most deprived areas. There are higher spatial inequalities in access in rural areas with ranges of 6.7% - 30.4% less access in comparison to 3.5% -26.2% for town and fringe, and 0.1% - 3.7% for urban areas – spatial inequalities in access are thus much smaller in urban areas.

| Deprivation Decile (IMD) | ALL | | Urban | | Town and Fringe | | Village, Hamlet & Isolated Dwellings | |
|--------------------------|--------------------|---------------------------|--------------------|---------------------------|--------------------|---------------------------|--------------------------------------|---------------------------|
| | % Access (20 mins) | Compared to Most Deprived | % Access (20 mins) | Compared to Most Deprived | % Access (20 mins) | Compared to Most Deprived | % Access (20 mins) | Compared to Most Deprived |
| 1 – least deprived | 90.1 | -9.6(-10.9,-8.2)* | 96.2 | -3.7(-4.2, -3.2)* | 80.8 | -17.9(-28.6, -7.3)* | 37.3 | -6.7 (-34.4, 21.1) |
| 2 | 82.7 | -16.8(-18.1,-15.5)* | 96.2 | -3.7(-4.2, -3.1)* | 72.3 | -26.2(-36.8, -15.6)* | 24.1 | -20.2 (-47.7, 7.4) |
| 3 | 80.3 | -19.3(-20.6, -18.0)* | 96.4 | -3.5(-4.0, -2.9)* | 79.1 | -19.6(-30.3, -8.8)* | 19.5 | -25.0 (-52.5, 2.6) |
| 4 | 79.1 | -20.2(-21.5, -18.9)* | 97.7 | -2.1(-2.6, -1.6)* | 77.5 | -20.9(-31.7, -10.1)* | 15.2 | -29.1 (-56.6, -1.6)* |
| 5 | 81.9 | -17.4(-18.7, -16.1)* | 98.1 | -1.8(-2.3, -1.3)* | 75.7 | -22.1(-32.9, -11.2)* | 14.0 | -30.4 (-58.0, -2.9)* |
| 6 | 87.6 | -12.2(-13.5, -10.9)* | 98.5 | -1.4(-1.9, -0.9)* | 83.2 | -15.6(-26.5, -4.6)* | 14.6 | -30.0 (-57.5, -2.4)* |
| 7 | 94.0 | -5.8 (-7.1, -4.5)* | 99.1 | -0.8(-1.3, -0.3)* | 88.8 | -10.4 (-21.6, .7) | 16.1 | -27.9 (-55.6, -0.1)* |
| 8 | 97.6 | -2.2 (-3.5, -0.9)* | 99.4 | -0.5(-1.0, 0.0)* | 88.6 | -11. (-22.6, .7) | 26.1 | -17.8 (-46.2, 10.6) |
| 9 | 99.5 | -0.3 (-1.6, 1.0) | 99.7 | -0.1 (-0.6, 0.3) | 95.7 | -3.5 (-16.1, 9.1) | 51.6 | 10.7 (-21.3, 42.7) |
| 10 – most deprived | 99.8 | 0 | 99.9 | 0 | 99.9 | 0 | 42.6 | 0 |

* Significant at p < 0.05

Table 1: The percentage of the population with access to a community pharmacy within a 20 minute walk by urbanity and deprivation decile (with 95% Confidence Intervals)

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5 Urban areas have the least difference between the most and least deprived LSOAs
6 with only 3.7% less of the population having access to a pharmacy within 20 minutes'
7 walk in the least deprived LSOAs. In town and fringe LSOAs this rose to 17.9%
8 difference, whilst in rural areas there was no significant difference between the least
9 and most deprived LSOAs.

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13 Overall, there is a clear dose-response relationship between access to community
14 pharmacies and urbanity levels. Specifically, the urban areas have more access to
15 community pharmacies, followed by Town/Fringe whilst the rural areas have the
16 least access to pharmacies – regardless of deprivation.

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20 After controlling for the effects of rurality, only 2 deprivation deciles have marginally
21 below 95% of the population being able to walk to a community pharmacy within 20
22 minutes.
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27 28 **Discussion**

29 *Principal findings of this study*

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31 The data has shown that 89 per cent of the population in England has access to a
32 community pharmacy within 20 minutes walk. Crucially, there is a positive trend
33 between community pharmacy accessibility and deprivation decile – with the highest
34 access in the most deprived areas – showing there is no inverse pharmacy law for
35 community pharmacy distribution in England. Indeed we have found evidence of a
36 *positive pharmacy care law*. Populations in urban areas of England also have better
37 access to a community pharmacy, compared to populations in town and fringe, and
38 rural areas.
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47 *Strengths and weaknesses*

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49 This study sought to explore the accessibility of community pharmacies in England by
50 walking distance: this is a key strength. We deliberately did not seek to explore
51 accessibility by car or by using public transport, as we feel this would not give a true
52 picture of accessibility for patients living in more deprived areas. Indeed, as access
53 to a car is linked to income – with households in underprivileged areas having less
54 access²⁶ – it is conceivable that this may be more of a significant barrier for patients
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3 living in deprived areas if the pharmacy was only accessible by driving; similarly, for
4 public transport, the cost of using such services may prove to be a barrier to
5 households with low incomes.²⁷ In terms of study limitations, while we believe our
6 results are robust and have important implications for the commissioning of
7 healthcare services from community pharmacy settings, we acknowledge that, in the
8 analysis, we did not consider the individual services offered from each community
9 pharmacy, which may show some local variability due to current commissioning
10 systems. We also acknowledge that our work only explores accessibility from a
11 geographical viewpoint and not a social perspective. Indeed, just because a
12 community pharmacy offers a healthcare service and is within walking distance of a
13 particular household does not necessarily mean that people perceive them as
14 valuable or would be willing to access the service. A study exploring the perceptions
15 and experiences of people – from various levels of deprivation – around the
16 accessibility of community pharmacy services is therefore warranted. In terms of a
17 methodological viewpoint, we recognize a 20-minute walk from each community
18 pharmacy was represented using a straight-line distance from the central point of
19 each pharmacy's postcode to create a buffer. This assumes people are able to walk
20 in any direction from that postcode and always in a straight-line. In reality people
21 are constrained to pathways that may curve, or even be cut off by barriers. A further
22 limitation is that of the postcodes themselves. An individual postcode represents an
23 average of 15 addresses, with the coordinates of each postcode being represented
24 using the geographic centroid of each postcode. Particularly in rural areas, where
25 houses are more sparsely spread, this could ostensibly mean that some households
26 will fall outside of a pharmacy buffer, when in fact this is not the case for some
27 addresses. Equally, however, some addresses will fall inside a buffer, so, over a large
28 population, one would expect this issue to even out.

50 51 *What is already known?*

52 There have been several mapping studies published exploring the distribution and
53 accessibility of community pharmacies in areas of America and Canada. For example,
54 a study by Lin (2004) explored the accessibility of community pharmacies by elderly
55 patients in Illinois and sought to estimate the disparity between urban and rural
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3 areas. The study found that, on average, there were 1.27 and 0.38 pharmacies per
4 10,000 people in urban and rural areas, respectively. In terms of accessibility, the
5 average distance for an elderly patient was 0.9 miles in urban areas but significantly
6 higher at 5.9 miles in rural areas.²⁸ While Law *et al.*, (2011) examined the
7 geographical access to community pharmacies in Ontario and found over 60 per cent
8 of the population reside within walking distance of at least one community
9 pharmacy.²⁹ Our original work shows geographical accessibility is even higher in
10 England. Despite studies published concerning community pharmacies in America
11 and Canada, there has been no study published in the literature that has explored
12 accessibility of community pharmacies in England. The recent White Paper
13 *Pharmacy in England: Building on Strengths – delivering the future*, published by the
14 Department of Health in 2008, claimed that, in England, 99 per cent of the
15 population can get to a pharmacy within 20 minutes by car and 96 per cent by
16 walking or using public transport.² However, whilst our report supports this finding
17 to some extent, it was not clear which methodological approach was used to obtain
18 this result, as, to the authors knowledge, no supporting data were published
19 outlining methodology; and – crucially - the Department of Health report did not
20 assess how varying levels of social deprivation influence the accessibility to a
21 community pharmacy. In addition, since the publication of the White Paper and
22 report, many more community pharmacies have since been opened in England.
23 Opening a new community pharmacy can be a complex process, as new applications
24 made to NHS England are assessed against a Pharmaceutical Needs Assessment for a
25 particular area³⁰ – with areas of the most need having a higher probability of a new
26 application being granted. It is, however, unlikely that the control of entry criteria
27 can fully explain our findings in relation to community pharmacy distribution, as
28 these regulations change over time and often have exemptions (e.g. up until recently
29 100 hour community pharmacies were exempt from the criteria).

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Previous research has shown that healthcare interventions delivered by community
pharmacies are accessible. By way of example, several small-scale studies have
compared accessibility of emergency hormonal contraception (EHC) from a
community pharmacy setting to other healthcare providers. These studies have
shown that women who went to a community pharmacy had more rapid access to

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3 EHC, compared to other settings, such as family planning clinics.³¹⁻³² Given that the
4 effectiveness of EHC is related to how quickly it is taken after unprotected sexual
5 intercourse this may prove to have a significant clinical benefit. Other studies, rather
6 than explore accessibility as such, have used community pharmacies to target
7 healthcare interventions towards 'hard to reach' areas. For example, Murphy *et al.*,
8 showed community pharmacies are convenient and accessible, and can provide
9 influenza vaccination programs in medically underserved communities, while Kellow
10 (2011) successfully delivered a community pharmacy weight management program
11 to young adults in a rural setting.³³⁻³⁴ These studies demonstrate the potential for
12 community pharmacies to deliver healthcare interventions to areas of the greatest
13 need.
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24 *Implications for policy makers*

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26 This is the first study to systematically explore the spatial distribution of community
27 pharmacies in England. It is also the first study that examines the relationship
28 between accessibility of community pharmacies and social deprivation and to
29 explore the idea of an *inverse pharmacy care law*. The paper shows that community
30 pharmacies are easily accessible by the majority of the population in England, with
31 89 per cent able access a community pharmacy within 20 minutes walk. Our study
32 also shows that there is no inverse pharmacy law for community pharmacies in
33 England: access to a community pharmacy is greater in areas of higher deprivation
34 compared to more affluent areas – a *positive pharmacy care law*. This is a very
35 timely finding as a recent initiative led by NHS England – the *Call to Action* – is
36 seeking to develop local strategy for community pharmacy initiatives and inform
37 strategic policy making in terms of commissioning community pharmacy services.³⁴
38 Our work supports this initiative and shows that community pharmacies are uniquely
39 placed in the community to deliver healthcare interventions. In addition, as the
40 accessibility of community pharmacies is greatest in areas of highest deprivation,
41 they may have an important role to play in reducing inequalities in priority public
42 health conditions in England.
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58 **Conclusions**

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3 Community pharmacies have the potential to offer convenient and equitable access
4 to healthcare. The vast majority of households in England – and especially those in
5 the most deprived areas – have access to a community pharmacy within 20 minutes
6 walk: a positive pharmacy care law. This potentially has major implications for the
7 commissioning of future services from community pharmacies in England.
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Contributorship statement

AT and CB conceptualised and designed the study and were involved in methodological development, analysis and interpretation. AC, AK and AH were involved in the development of the methods, data analysis and interpretation. AT led the drafting of the manuscript with input from all authors. All authors approved the final version and AT has responsibility for its final content.

Competing interests

None

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Data sharing

All of the primary data sources used to compile the database for this study are referenced within the manuscript. We are unable to share the study database but information related to it is available at: <https://www.dur.ac.uk/wolfson.institute/geohealth/>. The final raw analysed data is available by e-mailing AT (adam.todd@durham.ac.uk).

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4 **Figure legends**
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8 **Figure 1: Map of England with LSOA stratified according to deprivation (left); and**
9 **the population with access to a community pharmacy within 20 minutes walk**
10 **(right).**
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13 **Figure 2: Percentage of the Population with Access to a Pharmacy within 20**
14 **Minutes' Walk by Deprivation Decile before and after Adjusting for Urbanity**
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17 **Figure 3: Percentage of the Population with Access to a Pharmacy within 20**
18 **Minutes' Walk by Deprivation Decile before and after Adjusting for Urbanity**
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The Positive Pharmacy Care Law: An area-level analysis of the relationship
between community pharmacy distribution, urbanity and social deprivation in
England

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Keywords: Public health, pharmacies, health services accessibility

Word Count: 3023

Abstract

Objectives: To: (1) determine the percentage of the population in England that have access to a community pharmacy within 20 minutes walk; (2) explore any relationship between the walking distance and urbanity; (3) explore any relationship between the walking distance and social deprivation; and (4) explore any interactions between urbanity, social deprivation and community pharmacy access.

Design: This area level analysis spatial study used postcodes for all community pharmacies in England. Each postcode was assigned to a population lookup table and Lower Super Output Area (LSOA). The LSOA was then matched to urbanity (urban, town and fringe, or village, hamlet and isolated dwellings) and deprivation decile (using the Index of Multiple Deprivation score).

Primary outcome measure: Access to a community pharmacy within 20 minutes walk.

Results: Overall, 89.2% of the population is estimated to have access to a community pharmacy within 20 minutes walk. For urban areas, that is 98.3% of the population, for town and fringe, 79.9% of the population, whilst for rural areas, 18.9% of the population. For areas of lowest deprivation (deprivation decile 1) 90.1% of the population have access to a community pharmacy within 20 minutes walk, compared to 99.8% in areas of highest deprivation (deprivation decile 10), a percentage difference of 9.6% (8.2, 10.9).

Conclusions: Our study shows that the majority of the population can access a community pharmacy within 20 minutes walk and crucially, access is greater in areas of highest deprivation – a *positive pharmacy care law*. More research is needed to explore the perceptions and experiences of people – from various levels of deprivation – around the accessibility of community pharmacy services.

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Strengths and limitations of this study

- Our study is the first ~~internationally~~ to ~~systematically~~ examine whether there is an inverse care law in relation to community pharmacies and the first to analyse geographical access to services in England.
- A key strength of this study is that we examined accessibility of community pharmacies by walking distance; the cost of driving and using public transport can be significant barriers to travel and, as such, may not give a true account of community pharmacy accessibility.
- A possible limitation is that a 20 minute walk from each community pharmacy was represented using a straight-line distance from the central point of each pharmacy's postcode to create a buffer. This assumes people walk in straight lines while, in reality, people are constrained to pathways that curve or are sometimes cut off by barriers.
- ~~We did not consider the individual public health services offered from each community pharmacy~~

Background

The role of the community pharmacist has undergone rapid expansion in recent years with a significant emphasis now placed upon delivering ~~patient public health~~ focused ~~services~~ services, including promoting healthy lifestyles and modification of health-related behaviours, ~~as well as providing medicine related activities rather than just the traditional role of compounding and dispensing.~~^{1,2} This change has been acknowledged in England through the NHS contractual framework for ~~community pharmacy, which has 3 distinct levels of service as such, in England,~~ essential, advanced and locally commissioned.³ The essential and advanced levels of ~~service are provided by all community pharmacies in England and include dispensing medication and providing medicine use reviews (MURs), while the locally commissioned services are provided in response to needs of the local population. As such,~~ many community pharmacies now offer services, commissioned by local authorities ~~according to need~~, which are designed to help address public health ~~priority conditions~~ including smoking, alcohol misuse and obesity.⁴ These ~~issues~~

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conditions were identified by *The Strategic Review of Health Inequalities in England* (the Marmot Review) as significant modifiable risk factors for inequalities in morbidity and mortality in England.⁵⁴⁻⁵⁶ It is clear from the Marmot Review and other research that the way in which society is organised causes inequalities in these conditions, and inequalities in these conditions are, in turn, major contributions to overall inequalities in health, morbidity and mortality. Significantly, more people die from these conditions in disadvantaged areas compared to more affluent ones.²⁴⁻²⁶ Access to healthcare services is a well-established social determinant of health: disadvantaged areas often lack access to the level of NHS services that their health needs require (such as primary care services). This has been termed as an *Inverse Care Law*, as proposed by Tudor Hart in 1971, who stated *'the availability of good medical care tends to vary inversely with the need for it in the population served'*.¹⁰⁹ Rural areas are often disadvantaged in accessing health care services such as GP practices. Previous studies show that a 'distance decay' effect operates in accessing health care services in rural areas, with GP consultation rates declining as the distance from the GP surgery increases.¹¹⁰⁻¹¹² There is a common perception that people in rural areas are more affluent and therefore healthier than their urban counterparts, with a greater ability to adapt to, and access increasingly urbanised health services.¹²⁴⁻¹²⁶ For the older population, who tend to have greater health care needs accessing health care services may not be so easy, particularly those in rural areas where there may be a lack of suitable transport.¹²⁶

Community pharmacies have, to date, been overlooked in discussions around access to care, even though they could potentially make a significant contribution to this issue as there are over 12,000 community pharmacies in England, distributed across urban/rural and deprived/affluent areas. Estimates vary with regard to the reach of this community pharmacy network, but some sources suggest over 90% of the population makes at least one visit to the pharmacy per year.¹²⁶⁻¹²⁹ Evidence also suggests that a range of patients – of varying age, gender and social class – visit community pharmacies every month to collect prescriptions, purchase over-the-counter (OTC) medicine and obtain general healthcare advice.¹²⁹ Community pharmacies therefore appear to be uniquely placed to deliver public healthcare

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19 initiatives and can also be accessed without the patient needing a prior appointment.
20 This accessibility has consistently improved in recent years with policy drivers to
21 improve access to medicines – including the promotion of ‘self-care’ – with the
22 introduction of ‘100 hour pharmacies’, which must open 100 hours per week, for
23 every week of the year. However, it is not understood if community pharmacies
24 offer easy and equitable access to healthcare and therefore contribute too, or
25 ameliorate, the inverse care law. Clearly, as with other health-care services, for
26 community pharmacy ~~public-health~~ services to be successful and to contribute to
27 reducing inequalities in health, it is vital for these services to be available to the
28 areas and patient populations that need them most. This study, therefore, aims to:
29 (1) determine the percentage of the population in England that have access to a
30 community pharmacy within 20 minutes walk; (2) explore any relationship between
31 the walking distance (the accessibility) and urbanity; (3) explore any relationship
32 between the walking distance and social deprivation; and (4) explore any
33 interactions between urbanity, social deprivation and pharmacy access. The study is
34 the first ~~internationally~~ to examine whether there is an inverse care law in relation to
35 community pharmacies and the first to analyse geographical access to services in
36 England.

33 Methods

34 Study Design

35 This study explores the relationship between spatial access to community
36 pharmacies, deprivation and urbanity using geographical information systems and
37 generalized linear models.

37 Outcome

38 The percentage of the population that had access to a community pharmacy within a
39 20 minute walk by LSQA: measured as a straight line distance from each pharmacy
40 (1.6 km buffers) and aggregating the population by postcode within each buffer
41 compared to the LSQA population.

41 Definitions

42 Community Pharmacy: Registered with the General Pharmaceutical Council as
43 premises for the compounding, procurement, storage and distribution of medicines

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19 and appliances; we excluded premises that were solely registered as internet
20 pharmacies in the analysis.

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22 LSOA – Lower Super Output Area: Geographic areas in England comprising of
23 approximately 1,500 residents and 650 households. They are designed to be of a
24 reasonably compact shape whilst being representative of social homogeneity.²⁰

25 Urban/Rural Classification: Categorizes each LSOA into 3 settlement types: urban
26 (where the population is over 10,000 people), town and fringe (part of a settlement
27 with less than 10,000 people) or village, hamlet and isolated dwellings²¹

28 Deprivation decile: The term 'deprivation decile' is used to group the population into
29 ten equally spaced ordinal categories according to a particular level of deprivation.

Data and variables

30 Data were obtained from the [Fuse Geo-HealthCare Database](#). This database contains
31 data on the address and postcode of each community pharmacy in England
32 (obtained from the General Pharmaceutical Council – the independent regulator for
33 pharmacists, pharmacy technicians and pharmacy premises in Great Britain);²² the
34 postcode of each community pharmacy (matched to their corresponding coordinates
35 using the [Office of National Statistics postcode directory, 2012](#));²³ the coordinates
36 for each postcode in England (also from the [Office of National Statistics postcode](#)
37 [directory, 2012](#) - matched to a population lookup table and the Lower Super Output
38 Area [LSOA] for each postcode); whether the LSOA is urban (where the population is
39 over 10,000 people), town and fringe (part of a settlement with less than 10,000
40 people) or village, hamlet and isolated dwellings from the [urban/rural classification](#)
41 (2005)²¹ and the [Index of Multiple Deprivation score \(2010\)](#) for each LSOA (from the
42 [Office of National Statistics](#)).²⁴ More details on the [Fuse Geo-HealthCare Database](#)
43 are available here: <https://www.dur.ac.uk/wolfson.institute/geohealth/>

Analysis

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The community pharmacy postcodes for England were mapped using ArcMap. The average person walks 1 mile (1.6km) in 20 minutes²⁵ therefore 1.6 Km buffers were placed around each pharmacy to represent a 20 minute walk from a community pharmacy. The population postcodes were then clipped to the pharmacy buffers. Data on the sum of the population for each LSOA overall and within each community pharmacy buffer was extracted by LSOA. The percentage of the population with access to a pharmacy within 20 minutes walk was then calculated by LSOA. Whether or not the LSOA was urban, town and fringe or rural and the corresponding deprivation score was attached to the data file. Deprivation deciles were also calculated. The most deprived decile (10) equates to the most deprived 10% within a population, while the least deprived decile (1) represents the 10% of a population living in the least deprived circumstances. Each data set was then mapped using Arc GIS. Tables were produced to show the percentage of the population who had access to a pharmacy within 20 minutes walk by deprivation decile and by urban/rural classification within the deprivation deciles. Generalised linear models were used to adjust for rurality within each deprivation decile to produce urban/rural adjusted prevalence rates of the percentage of households with access to a pharmacy within 20 minutes walk by LSOA and the results tabulated.

Data and variables

Data were obtained from the Durham Geo-HealthCare Database. This database contains data on the address and postcode of each community pharmacy in England (obtained from the General Pharmaceutical Council – the independent regulator for pharmacists, pharmacy technicians and pharmacy premises in Great Britain)^{26,27} the postcode of each community pharmacy (matched to their corresponding coordinates using the Office of National Statistics postcode directory, 2012),²⁸ the coordinates for each postcode in England (also from the Office of National Statistics postcode directory, 2012 – matched to a population lookup table and the Lower Super Output Area [LSOA] for each postcode); whether the LSOA is urban (where the population is over 10,000 people), town and fringe (part of a settlement with less than 10,000 people) or village, hamlet and isolated dwellings from the urban/rural classification (2005)²⁹ and the index of Multiple Deprivation score (2010) for each LSOA (from the

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Office of National Statistics).^{23*} More details on the Durham Geo-HealthCore Database are available here: <https://www.dur.ac.uk/wolfson.institute/geohealth/>

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Analysis

The community pharmacy postcodes for England were mapped using ArcMap. The average person walks 1 mile (1.6 km) in 20 minutes,²⁴ therefore 1.6 Km buffers were placed around each pharmacy to represent a 20 minute walk from a community pharmacy. The population postcodes were then clipped to the pharmacy buffers. Data on the sum of the population for each LSOA overall and within each community pharmacy buffer was extracted by LSOA. The percentage of the population with access to a pharmacy within 20 minutes walk was then calculated by LSOA. Whether or not the LSOA was urban, town and fringe or rural and the corresponding deprivation score was attached to the data file. Deprivation deciles were also calculated. The term 'deprivation decile' is used to group the population into ten equally spaced ordinal categories according to a particular level of deprivation. Thus, the most deprived decile (10) equates to the most deprived 10% within a population, while the least deprived decile (1) represents the 10% of a population living in the least deprived circumstances. Each data set was then mapped using Arc GIS. Tables were produced to show the percentage of the population who had access to a pharmacy within 20 minutes walk by deprivation decile and by urban/rural classification within the deprivation deciles. Generalised linear models were used to adjust for rurality within each deprivation decile to produce urban/rural adjusted prevalence rates of the percentage of households with access to a pharmacy within 20 minutes walk by LSOA and the results tabulated.

Results

Urban Rural/ Deprivation Decile Access

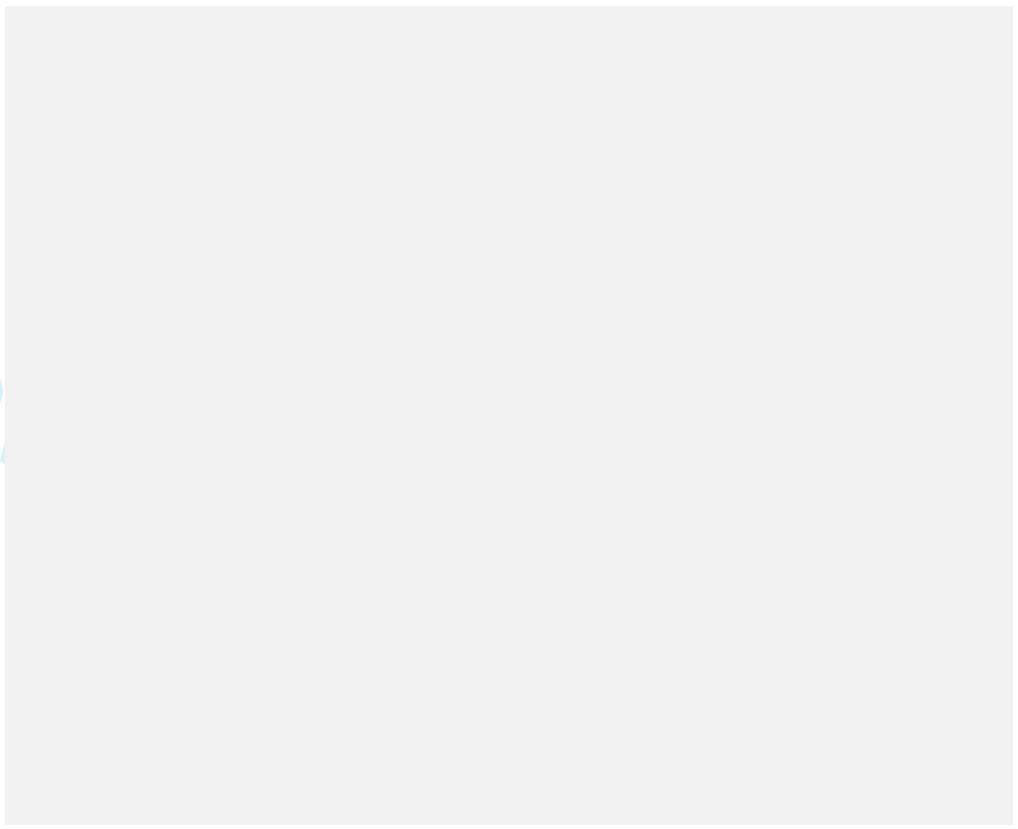
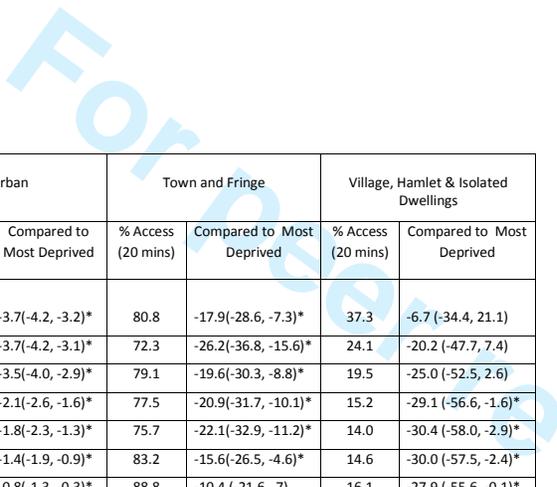
Data for all of the LSOAs in England shows that 89.2% of the population has access to a community pharmacy within 20 minutes walk. 98.3% of the households in the urban areas are estimated to have access to a pharmacy within 20 minutes walk. In town and fringe, the percentage of households that have access to a community

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pharmacy is estimated as 79.9% whilst the percentage of those in the rural areas is estimated as 18.9%.

The distributions of percentages of households with access to a community pharmacy within 20 minutes are presented in Table 1 (and shown spatially in Figures 2 and 34) according to their deprivation decile and urban, town and fringe and rural areas. There is a significant non-linear association between the deprivation deciles (a u-shaped access curve, see Figure 32): the least deprived and most deprived households have more access to a pharmacy than the households in the middle of the deprivation range. Overall, the inequalities in access to pharmacies in England range between 0.3% less and 20.2% less access when compared to the most deprived areas. There are higher spatial inequalities in access in rural areas with ranges of 6.7% - 30.4% less access in comparison to 3.5% -26.2% for town and fringe, and 0.1% - 3.7% for urban areas – spatial inequalities in access are thus much smaller in urban areas.

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| Deprivation Decile (IMD) | ALL | | Urban | | Town and Fringe | | Village, Hamlet & Isolated Dwellings | |
|--------------------------|--------------------|---------------------------|--------------------|---------------------------|--------------------|---------------------------|--------------------------------------|---------------------------|
| | % Access (20 mins) | Compared to Most Deprived | % Access (20 mins) | Compared to Most Deprived | % Access (20 mins) | Compared to Most Deprived | % Access (20 mins) | Compared to Most Deprived |
| 1 – least deprived | 90.1 | -9.6(-10.9, -8.2)* | 96.2 | -3.7(-4.2, -3.2)* | 80.8 | -17.9(-28.6, -7.3)* | 37.3 | -6.7 (-34.4, 21.1) |
| 2 | 82.7 | -16.8(-18.1, -15.5)* | 96.2 | -3.7(-4.2, -3.1)* | 72.3 | -26.2(-36.8, -15.6)* | 24.1 | -20.2 (-47.7, 7.4) |
| 3 | 80.3 | -19.3(-20.6, -18.0)* | 96.4 | -3.5(-4.0, -2.9)* | 79.1 | -19.6(-30.3, -8.8)* | 19.5 | -25.0 (-52.5, 2.6) |
| 4 | 79.1 | -20.2(-21.5, -18.9)* | 97.7 | -2.1(-2.6, -1.6)* | 77.5 | -20.9(-31.7, -10.1)* | 15.2 | -29.1 (-56.6, -1.6)* |
| 5 | 81.9 | -17.4(-18.7, -16.1)* | 98.1 | -1.8(-2.3, -1.3)* | 75.7 | -22.1(-32.9, -11.2)* | 14.0 | -30.4 (-58.0, -2.9)* |
| 6 | 87.6 | -12.2(-13.5, -10.9)* | 98.5 | -1.4(-1.9, -0.9)* | 83.2 | -15.6(-26.5, -4.6)* | 14.6 | -30.0 (-57.5, -2.4)* |
| 7 | 94.0 | -5.8 (-7.1, -4.5)* | 99.1 | -0.8(-1.3, -0.3)* | 88.8 | -10.4 (-21.6, .7) | 16.1 | -27.9 (-55.6, -0.1)* |
| 8 | 97.6 | -2.2 (-3.5, -0.9)* | 99.4 | -0.5(-1.0, 0.0)* | 88.6 | -11. (-22.6, .7) | 26.1 | -17.8 (-46.2, 10.6) |
| 9 | 99.5 | -0.3 (-1.6, 1.0) | 99.7 | -0.1 (-0.6, 0.3) | 95.7 | -3.5 (-16.1, 9.1) | 51.6 | 10.7 (-21.3, 42.7) |
| 10 – most deprived | 99.8 | 0 | 99.9 | 0 | 99.9 | 0 | 42.6 | 0 |

* Significant at p < 0.05

Table 1: The percentage of the population with access to a community pharmacy within a 20 minute walk by urbanity and deprivation decile (with 95% Confidence Intervals).

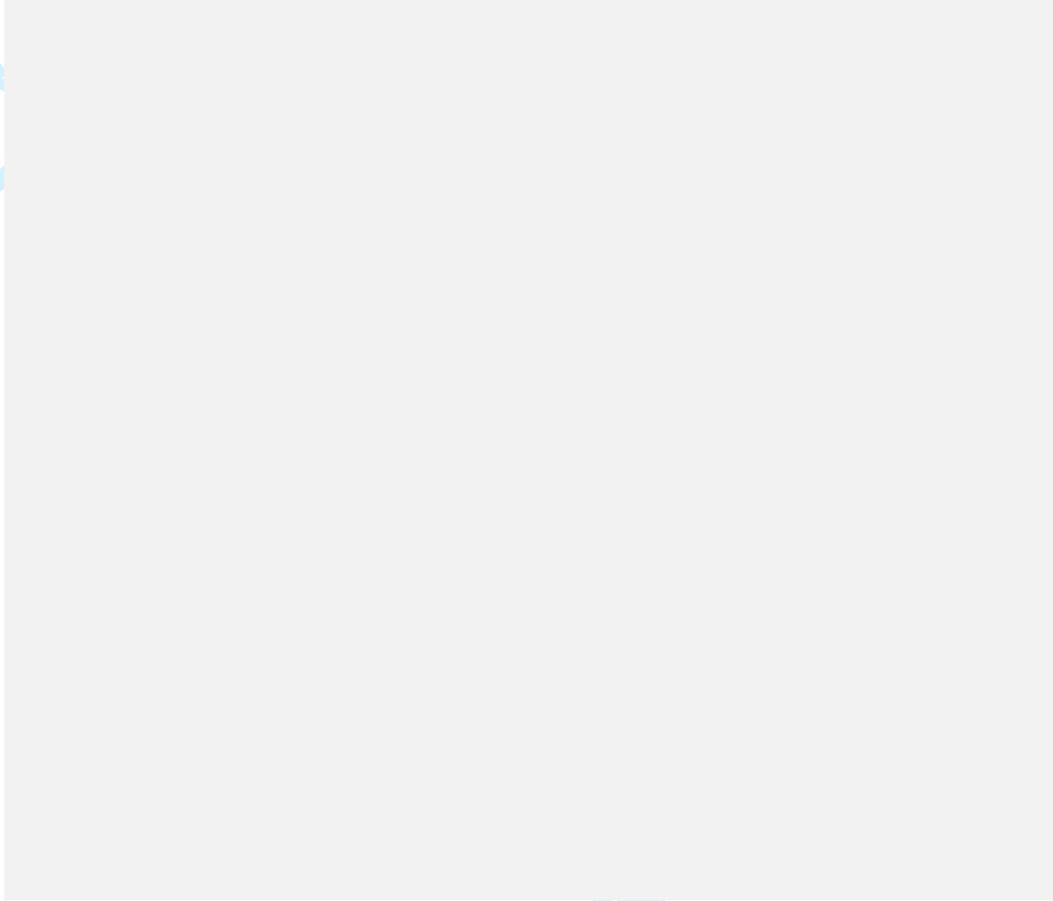
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[\[Insert Figure 1 here\]](#)

Figure 1: Map of England with LSOA stratified according to deprivation

[\[Insert Figure 2 here\]](#)

Figure 2: Map of England showing the population with access to a community pharmacy within 20 minutes walk.



[Insert Figure 3 here]

Figure 3: Percentage of the Population with Access to a Pharmacy within 20 Minutes' Walk by Deprivation Decile before and after Adjusting for Urbanity

Urban areas have the least difference between the most and least deprived LSOAs with only 3.7% less of the population having access to a pharmacy within 20 minutes' walk in the least deprived LSOAs. In town and fringe LSOAs this rose to 17.9% difference, whilst in rural areas there was no significant difference between the least and most deprived LSOAs.

Overall, there is a clear dose-response relationship between access to community pharmacies and urbanity levels. Specifically, the urban areas have more access to community pharmacies, followed by Town/Fringe whilst the rural areas have the least access to pharmacies – regardless of deprivation.

After controlling for the effects of rurality, only 2 deprivation deciles have marginally below 95% of the population being able to walk to a community pharmacy within 20 minutes.

Finally, in order to investigate interactions between deprivation deciles and urbanity levels we compared the difference in the percentage of the population that have access to a pharmacy within 20 minutes' walk between urbanity levels across the deprivation deciles (Table 2). There is a significant difference between urban and town/fringe in all deprivation deciles except the most deprived (decile 10). The biggest differences in access to community pharmacies are between urban and rural areas. There are significant interactions between access to community pharmacies and urbanity levels: difference in access depends on deprivation decile. The inequality gap between urban and town/fringe for the least and the most deprived areas are 15.1% and 0.9%, respectively. For the comparison between urban and rural areas, the inequality gap for the least and most deprived areas are 58.3% and 55.3%, respectively. Whilst the gap between town/fringe and rural areas are 43.2% and 54.5% respectively for the least and most deprived areas. In addition, there is a clear dose-response relationship between access to community pharmacies and

urbanity levels. Specifically, the urban areas have more access to community pharmacies, followed by Town/Fringe whilst the rural areas have the least access to pharmacies – regardless of deprivation.

| Deprivation Decile | Urban—Town/Fringe Difference | Urban—Rural Difference | Town/Fringe—Rural Difference |
|--------------------|--------------------------------|--------------------------------|--------------------------------|
| 1—Least deprived | 15.1 (12.7, 17.5) [†] | 58.3 (24.5, 62.2) [†] | 43.2 (38.0, 47.5) [†] |
| 2 | 22.4 (20.7, 26.0) [†] | 71.8 (68.0, 74.7) [†] | 48.4 (44.0, 52.0) [†] |
| 3 | 16.0 (14.4, 19.5) [†] | 76.8 (74.5, 79.1) [†] | 59.4 (56.8, 63.0) [†] |
| 4 | 19.7 (17.2, 22.1) [†] | 82.3 (80.3, 84.3) [†] | 62.7 (59.8, 65.5) [†] |
| 5 | 21.1 (18.7, 23.5) [†] | 84.0 (81.0, 86.0) [†] | 62.9 (59.0, 65.7) [†] |
| 6 | 15.0 (12.8, 17.2) [†] | 83.0 (81.8, 85.0) [†] | 68.0 (66.1, 71.7) [†] |
| 7 | 10.5 (8.6, 12.4) [†] | 82.4 (80.2, 84.5) [†] | 71.9 (69.1, 74.7) [†] |
| 8 | 11.3 (9.5, 13.1) [†] | 73.6 (69.7, 75.5) [†] | 31.3 (58.0, 64.6) [†] |
| 9 | 4.2 (2.8, 5.6) [†] | 44.5 (40.7, 48.3) [†] | 40.3 (36.2, 44.3) [†] |
| 10—Most deprived | 0.9 (-0.2, 1.9) | 55.3 (50.8, 58.1) [†] | 54.5 (50.8, 58.1) [†] |

[†] Significant at p < 0.05

Table 2: Difference in the percentage of the population that have access to a pharmacy within 20 minutes' walk between urbanity levels and deprivation bands

Discussion

Principal findings of this study

The data has shown that 89 per cent of the population in England has access to a community pharmacy within 20 minutes walk. Crucially, there is a positive trend between community pharmacy accessibility and deprivation decile – with the highest access in the most deprived areas – showing there is no inverse pharmacy law for community pharmacy distribution in England. Indeed we have found evidence of a *positive pharmacy care law*. Populations in urban areas of England also have better access to a community pharmacy, compared to populations in town and fringe, and rural areas.

Strengths and weaknesses

This study sought to explore the accessibility of community pharmacies in England by walking distance: this is a key strength. We deliberately did not seek to explore accessibility by car or by using public transport, as we feel this would not give a true picture of accessibility for patients living in more deprived areas. Indeed, as access to a car is linked to income – with households in underprivileged areas having less access^{25,4} – it is conceivable that this may be more of a significant barrier for patients living in deprived areas if the pharmacy was only accessible by driving; similarly, for public transport, the cost of using such services may prove to be a barrier to households with low incomes.^{25,5} In terms of study limitations, while we believe our results are robust and have important implications for the commissioning of **public-healthcare** services from community pharmacy settings, we acknowledge that, in the analysis, we did not consider the individual services offered from each community pharmacy, which may show some local variability due to current commissioning systems. We also acknowledge that our work only explores accessibility from a geographical viewpoint and not a social perspective. Indeed, just because a community pharmacy offers a **public-healthcare** service and is within walking distance of a particular household does not necessarily mean that people perceive them as valuable or would be willing to access the service. ~~Indeed, the literature shows that most users of community pharmacies are not offered public health services, although for those that had used them, satisfaction levels were high.²⁶ However, it is not yet known if people perceive community pharmacies as easily accessible providers of healthcare or if (or how) these perceptions change according to deprivation.~~ A study exploring the perceptions and experiences of people – from various levels of deprivation – around the accessibility of community pharmacy services is therefore warranted. In terms of a methodological viewpoint, we recognize a 20-minute walk from each community pharmacy was represented using a straight-line distance from the central point of each pharmacy's postcode to create a buffer. This assumes people are able to walk in any direction from that postcode and always in a straight-line. In reality people are constrained to pathways

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that may curve, or even be cut off by barriers. A further limitation is that of the postcodes themselves. An individual postcode represents an average of 15 addresses, with the coordinates of each postcode being represented using the geographic centroid of each postcode. Particularly in rural areas, where houses are more sparsely spread, this could ostensibly mean that some households will fall outside of a pharmacy buffer, when in fact this is not the case for some addresses. Equally, however, some addresses will fall inside a buffer, so, over a large population, one would expect this issue to even out.

What is already known?

There have been several mapping studies published exploring the distribution and accessibility of community pharmacies in areas of America and Canada. For example, a study by Lin (2004) explored the accessibility of community pharmacies by elderly patients in Illinois and sought to estimate the disparity between urban and rural areas. The study found that, on average, there were 1.27 and 0.38 pharmacies per 10,000 people in urban and rural areas, respectively. In terms of accessibility, the average distance for an elderly patient was 0.9 miles in urban areas but significantly higher at 5.9 miles in rural areas.^{22, 23} While Law *et al.*, (2011) examined the geographical access to community pharmacies in Ontario and found over 60 per cent of the population reside within walking distance of at least one community pharmacy.^{24, 25} Our original work shows geographical accessibility is even higher in England. Despite studies published concerning community pharmacies in America and Canada, there has been no study published in the literature that has explored accessibility of community pharmacies in England. The recent White Paper *Pharmacy in England: Building on Strengths – delivering the future*, published by the Department of Health in 2008, claimed that, in England, 99 per cent of the population can get to a pharmacy within 20 minutes by car and 96 per cent by walking or using public transport.² However, whilst our report supports this finding to some extent, it was not clear which methodological approach was used to obtain this result, as, to the authors knowledge, no supporting data were published outlining methodology; and – crucially – the Department of Health report did not assess how varying levels of social deprivation influence the accessibility to a

community pharmacy. In addition, since the publication of the White Paper and report, many more community pharmacies have since been opened in England.

~~Opening a new community pharmacy can be a complex process, as new applications made to NHS England are assessed against a Pharmaceutical Needs Assessment for a particular area²⁹ – with areas of the most need having a higher probability of a new application being granted. It is, however, unlikely that the control of entry criteria can fully explain our findings in relation to community pharmacy distribution, as these regulations change over time and often have exemptions (e.g. up until recently 100 hour community pharmacies were exempt from the criteria).~~

~~Previous research has shown that healthcare interventions delivered by community pharmacies are accessible, can potentially make a positive contribution toward improving the public's health, areas of particular strengths appear to be related to interventions around smoking cessation, lipid management, emergency hormonal contraception and immunization.²⁹ By way of example, several small-scale studies have compared accessibility of emergency hormonal contraception (EHC) from a community pharmacy setting to other healthcare providers. These studies have shown that women who went to a community pharmacy had more rapid access to EHC, compared to other settings, such as family planning clinics.^{20,21,24,32} Given that the effectiveness of EHC is related to how quickly it is taken after unprotected sexual intercourse this may prove to have a significant clinical benefit. Other studies, rather than explore accessibility as such, have used community pharmacies to target public health care interventions towards 'hard to reach' areas. For example, Murphy *et al.*, showed community pharmacies are convenient and accessible, and can provide influenza vaccination programs in medically underserved communities, while Kellow (2011) successfully delivered a community pharmacy weight management program to young adults in a rural setting.^{24,32,34} These studies demonstrate the potential for community pharmacies to deliver public health care interventions to areas of the greatest need.~~

Implications for policy makers

~~This is the first study to systematically explore the spatial distribution of community pharmacies in England. It is also the first study that examines the relationship~~

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between accessibility of community pharmacies and social deprivation and to explore the idea of an *inverse pharmacy care law*. The paper shows that community pharmacies are easily accessible by the majority of the population in England, with 89 per cent able access a community pharmacy within 20 minutes walk. Our study also shows that there is no inverse pharmacy law for community pharmacies in England: access to a community pharmacy is greater in areas of higher deprivation compared to more affluent areas – a *positive pharmacy care law*. This is a very timely finding as a recent initiative led by NHS England – the *Call to Action* – is seeking to develop local strategy for community pharmacy initiatives and inform strategic policy making in terms of commissioning community pharmacy services.³⁴ Our work supports this initiative and shows that community pharmacies are uniquely placed in the community to deliver *public-healthcare* interventions. In addition, as the accessibility of community pharmacies is greatest in areas of highest deprivation, they may have an important role to play in reducing inequalities in priority public health conditions in England.

Conclusions

Community pharmacies have the potential to offer convenient and equitable access to healthcare. The vast majority of households in England – and especially those including those in the most deprived areas – have access to a community pharmacy within 20 minutes walk: a positive pharmacy care law. This potentially has major implications for the commissioning of future *public-health* services from community pharmacies in England.

Contributorship statement

AT and CB conceptualised and designed the study and were involved in methodological development, analysis and interpretation. AC, AK and AH were involved in the development of the methods, data analysis and interpretation. AT led the drafting of the manuscript with input from all authors. All authors approved the final version and AT has responsibility for its final content.

Competing interests

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None

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Data sharing

All of the primary data sources used to compile the database for this study are referenced within the manuscript. We are unable to share the study database but information related to it is available at: <https://www.dur.ac.uk/wolfson.institute/geohealth/>. The final raw analysed data is available by e-mailing AT (adam.todd@durham.ac.uk).

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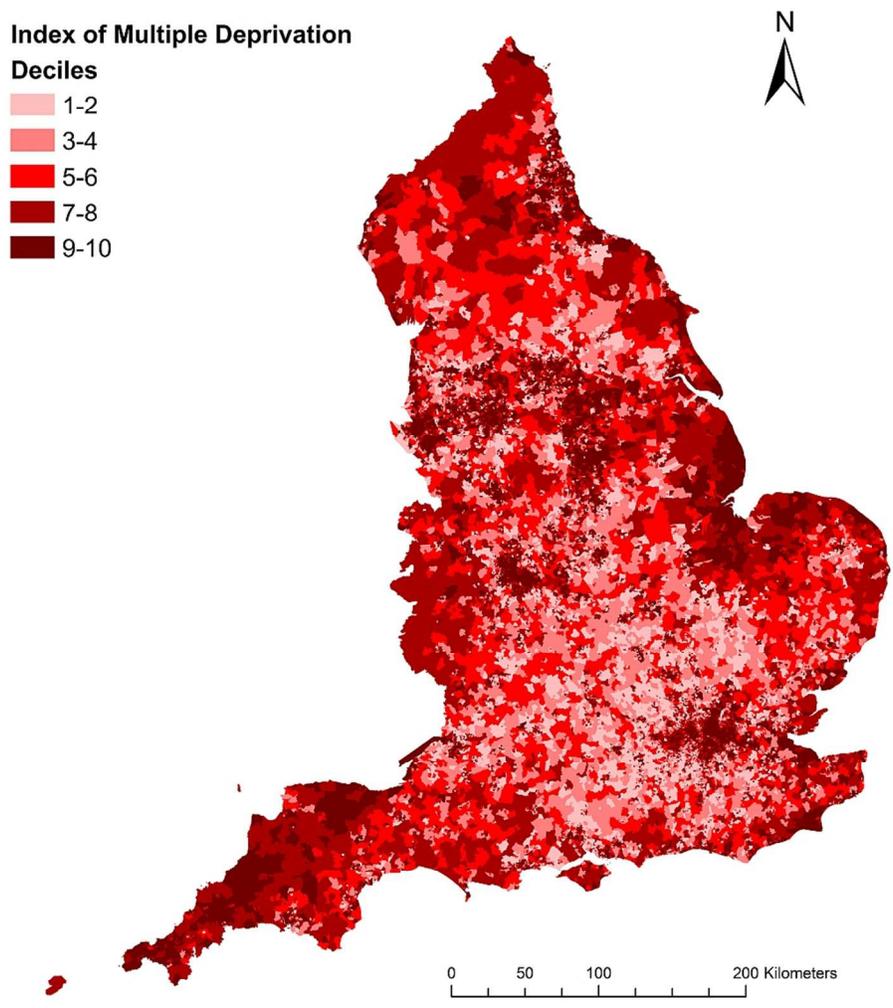


Figure 1: Map of England with LSOA stratified according to deprivation
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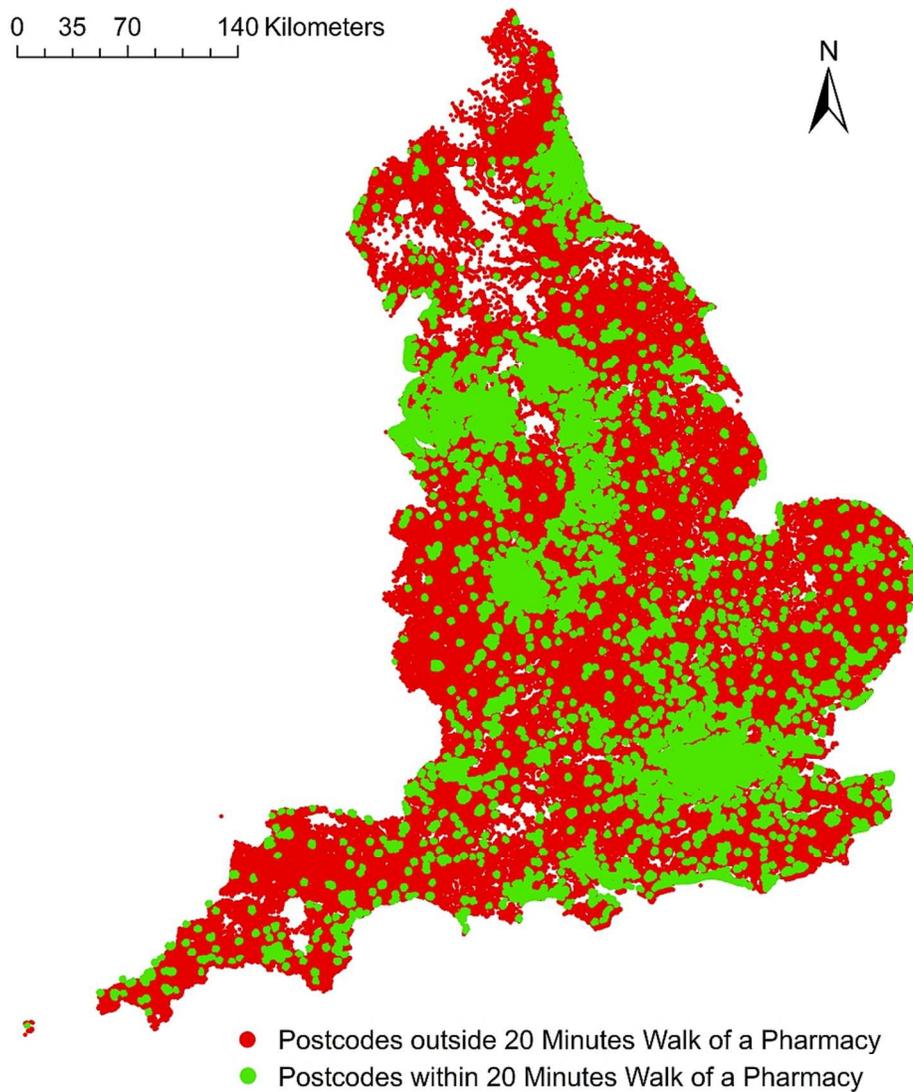


Figure 2: Map of England showing the population with access to a community pharmacy within 20 minutes walk.
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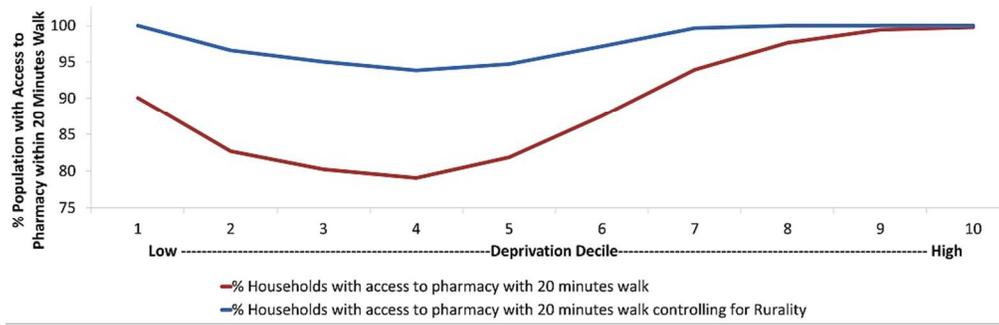


Figure 3: Percentage of the Population with Access to a Pharmacy within 20 Minutes' Walk by Deprivation Decile before and after Adjusting for Urbanity
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